

a

CLAIMS What is claimed

1. A method and apparatus for reproducing audio sound by means of an ultrasound-producing device, wherein the audio signal to be reproduced is linked by side band amplitude modulation to a carrier signal in the ultrasonic frequency range, wherein there are provided means for subjecting the modulated ultrasonic signal to dynamic error compensation and the compensated ultrasonic signal is possibly subjected to frequency characteristic linearisation and is then passed to an ultrasonic transducer (loudspeaker), wherein there are provided means for reducing the amplitude of the ultrasonic carrier signal (carrier reduction).

2. A method and apparatus as set forth in claim 1 characterised in that the ultrasonic signal is suppressed (muted) in modulation breaks, when therefore no audio signal is to be reproduced.

3. A method and apparatus as set forth in one of the preceding claims characterised in that the audio signal which is to be reproduced (which is still of low frequency) is subjected to frequency characteristic linearisation prior to modulation.

4. A method and apparatus as set forth in one of the preceding claims characterised in that the audio signal to be reproduced is subjected to double side band amplitude modulation or single side band amplitude modulation.

5. A method and apparatus as set forth in one of the preceding claims characterised in that there are provided means for suppressing the ultrasonic carrier by an amount of between about 8 and 20 dB, preferably 12 dB.

10006703.030502

10009703.030502

6. A method and apparatus as set forth in one of the preceding claims characterised in that the frequency of the ultrasonic carrier signal is in the range of between about 40 kHz and 500 kHz.

7. A method and apparatus as set forth in one of the preceding claims characterised in that in a double side band amplitude modulation procedure there are provided means for suppressing the lower side band.

8. A method and apparatus as set forth in one of the preceding claims characterised in that there are provided means for effecting distortion removal (frequency characteristic linearisation) after amplitude modulation.

9. A method and apparatus as set forth in one of the preceding claims characterised in that there is provided a plurality of ultrasonic transducers which are connected in parallel.

10. A method and apparatus as set forth in claim 9 characterised in that the transducers are arranged as densely as possible on a plate.

11. A method and apparatus as set forth in one of the preceding claims characterised in that modulation is effected by means of a digital signal processor.

12. A method and apparatus as set forth in one of the preceding claims characterised in that a water-air bubble mixture is arranged in the ultrasound propagation path.

13. A method and apparatus as set forth in claim 12 characterised in that the water-air bubble mixture is provided in a headset earpiece.

14. A method and apparatus as set forth in one of the preceding claims characterised in that arranged in the path of propagation of the

ultrasonic beams is a sound-transmissive medium containing cavities which together with the medium material have a plurality of Helmholtz resonators which are preferably tuned to the first harmonic of the ultrasonic signal.

15. A method and apparatus as set forth in claim 14 characterised in that the cavities are filled with a non-linear medium.

16. A method and apparatus as set forth in one of the preceding claims characterised in that a plurality of ultrasonic transducers are arranged in an annular array.

17. A method and apparatus as set forth in one of the preceding claims characterised in that the ultrasonic carrier signal and the side band signal are fed to separate transducers.

18. A method and apparatus as set forth in one of the preceding claims characterised in that the aperture angle of an ultrasonic transducer is approximately in the range of between 0.5 and 10°, preferably 1°.

19. A method and apparatus as set forth in one of the preceding claims characterised in that there are provided means for subjecting the audio signal to a pre-distortion effect.

20. A method and apparatus as set forth in one of the preceding claims characterised in that there are means for pivoting the ultrasonic beam into a desired direction.

21. A method and apparatus as set forth in claim 20 characterised in that the means for pivoting the ultrasonic beam comprise a mechanical pivoting device for the ultrasonic radiating device and/or electronic actuation of the ultrasonic radiating devices in the manner of a so-called 'phased array' and/or that there is a pivotable reflector which reflects the ultrasound into a desired direction.

10009703.030502

22. A method and apparatus as set forth in one of the preceding claims characterised in that the ultrasonic apparatus forms an ultrasonic wallpaper so that when listening the impression is that the sound is coming directly from the wall (or from the wallpaper on the wall).

23. A method and apparatus as set forth in one of the preceding claims characterised in that the carrier band of the ultrasonic radiating band and the ultrasonic beam side band are produced with different transducers.

24. A method and apparatus as set forth in one of the preceding claims characterised in that the audio LF signal is subjected to psychoacoustic pre-processing (in particular psychoacoustic pre-distortion) and there are provided suitable means therefor.

25. A method and apparatus as set forth in one of the preceding claims characterised in that the apparatus is in the form of an acoustic travelator so that when a listener is moving past an ultrasonic transducer only the moving listener is radiated with sound but not the surrounding area in space.

26. A method and apparatus as set forth in one of the preceding claims characterised in that there is provided at least one ultrasonic transducer which exclusively or additionally to ultrasonic irradiation serves as a transmitting and/or receiving device of a distance-measuring device based on ultrasound.

27. A method and apparatus as set forth in one of the preceding claims characterised in that the properties of the audio signal to be reproduced, in particular the lower limit frequency thereof, are determined by the magnitude of the reflection area in order thereby preferably to

compensate for frequency characteristic linearisation or distortion removal of the audio signal.

28. A method and apparatus as set forth in one of the preceding claims characterised in that the audio signal to be reproduced is subjected in a modulator to frequency and/or phase modulation.

29. Use of an ultrasonic reproduction apparatus as set forth in one of the preceding claims in an art exhibition and/or in a museum or for active noise compensation and/or in conference systems and/or as a loudspeaker as a headset substitute and/or for directed sound radiation on a stage (prompter) and/or as an addressable loudspeaker and/or for sound radiation of computer workstations and/or as a surround loudspeaker and/or for acoustic irradiation of quite specific zones and/or in a hands-free device.

30. Use as set forth in one of the preceding claims for sound irradiation of a region through which the listener is moving or through which the listener is moved, wherein the reproduction level of the ultrasonic signal is always directed to the moving listener.

Added